

Example 7: A telecommunications satellite orbits the Earth once every 24 hours in what is called a geosynchronous orbit. What is the altitude of this satellite?

$$T = 24 \text{ h} \times \frac{3600 \text{ s}}{1 \text{ h}} = 8.64 \times 10^4 \text{ s}$$

→ use  $F_c = F_g$  for orbiting satellite

$$\frac{m 4\pi^2 r}{T^2} = \frac{GMm}{r^2}$$

$$r^3 = \frac{GMT^2}{4\pi^2}$$

note →

$$r = \sqrt[3]{\frac{(6.67 \times 10^{-11})(5.98 \times 10^{24})(8.64 \times 10^4)^2}{4\pi^2}}$$

$$r = 4.225 \times 10^7 \text{ m}$$

so altitude =  $(4.225 \times 10^7) - (6.38 \times 10^6)$

$$\boxed{\text{alt} = 3.6 \times 10^7 \text{ m}}$$